An Exploration of the Role of Smartphones: Mobile Technology Expanding The Learning Environment Outside of the Classroom.

This study's paper was produced for the completion of UOIT's M.Ed. Program under the supervision of Dr. François Desjardins.

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Abstract

Smartphones effectively expand the learning environment outside of the traditional classroom. Secondary school students enrolled in grade 10 and grade 11 communication technology courses were recruited to participate in a treatment and research project that utilized smartphones. Their opinions of these devices were polled both before and after the treatment's activity. The treatment required the students to use their smartphones outside of the classroom to access the expectations of a broadcasting assignment; conduct secondary research and use their smartphone's built-in video camera to record a news report segment while remaining in contact with their educator through their device. Once the students returned to the classroom, they uploaded their assignment video to a secure hard drive. Prior to the activity students viewed the smartphone as primarily a social and entertainment device. However, upon completion of this treatment, participants viewed the smartphone as a valid learning tool outside the classroom. This finding supported the literature that examined the perceived values of the smartphones. This result was consistent with the literature that examined the perceived values of smartphones as a learning tool by students.

Keywords: mobile learning, telecommunication, smartphones, project-based learning, communication technology, secondary technological studies.

An Exploration of the Role of Smartphones: Mobile Technology Expanding The Learning Environment Outside of the Classroom.

The importance and adoption of mobile technology by society, especially of smartphones, has led to the new educational approach mobile learning or m-learning. Mobile technology consists of compact communication devices, such as smartphones, that allow information to be pushed/pulled in a variety of formats through voice recognition/recording, touch screen or built in keyboard texting and Internet capabilities. By a merging of cellular phones and personal digital assistants (PDAs), smartphones have expanded where and how we communicate. Smartphones are mobile devices that offer more advanced computing and connectivity abilities than previous mobile technology. These devices also have the benefit of various multimedia capabilities such as audio, video and still camera recording as well as various applications that can be added. Smartphone applications, referred to in this paper by the more commonly known name apps, are small software applications that specifically designed for smartphones and other mobile devices (Wikipedia, 2012). With the number of apps available, smartphones effectively expand the learning environment both inside and outside the classroom.

Although this topic was initially explored and researched more at the post secondary level, interest in adopting the use of smartphones as a learning tool has grown both at the elementary and secondary level with published literature and school board projects that harness the tools smartphones have to offer. Examples of these local initiatives include: The Waterloo Region District School Board of Ontario's kindergarten iPad project (Mackie & Harper, 2011), The Near North District School Board's Mobile Learning Initiative (Walkling, 2011) and St. Mary's City School District of New Jersey's Mobile Devices Drive Creative Instruction

(Pruente, 2012). This growth indicates increasing interest at the elementary and secondary levels about the potential that these devices have to expand the learning environment.

Smartphones' ubiquitous nature, due to their multi-functional and convenience aspects, has led to the common viewpoint that they are essential tools both personally and professionally. In education there are conflicting viewpoints about the purpose of these devices; the question arises are they beneficial or merely a distraction? According to Hsi (2007) and Pretorius, Steyn, & Johnson (2012), there is conflicting viewpoints on the role of smartphone and other ICT technology in education. Some viewpoints indicate these devices are valuable, while other articles view these devices as more of a distraction. More research is needed to aid in the development of a thoughtful and consistent smartphone policy for the classroom.

Along with examination of the view of these devices by educators, the perceived role and value of these devices by secondary school students must be examined. How are these devices currently being utilized in their lives and where do they perceive these devices will be able to expand learning outside of the formal classroom? With no clear and common policy in the educational world, students are receiving mixed messages about the role and utility of smartphones. This study demonstrates how these devices maybe used in a constructive manner to expand the learning environment outside of the traditional classroom. Specifically, in the curriculum for Communications Technology, this study demonstrates that new telecommunications ICT technology can provide curriculum-based learning.

Literature Review

Mobile Technology in Society

The interest in mobile devices and their role in education have grown due to the changes in how society communicates and gathers information in the new millennium. It is important to examine the devices employed by society in order to develop an effective methodology for this technology's use in education. With the evolution of telecommunication devices, communication has expanded from primarily being face-to-face to utilizing mobile devices.

Hallen suggested that mobile devices fall under the category of telecommunication. The term telecommunication refers to the transmission of information over a significant distance and it has evolved with the development and adoption of ICT (information and communication technology). Information and communication technology (ICT) is an umbrella term that includes all technologies such as fiber optics, Internet and satellites for the communication of information (Hallen, 1999).

With the introduction of mobile devices like the smartphone, it is necessary that society expands and incorporates a new set of skills in order to communicate effectively. It is the author's opinion that with any new technology, today's student needs to be able to distinguish between the merits and challenges of these devices as well as recognize their potential knowledge sources in a given situation and then choose the correct device and use it appropriately. The knowledge gained from this skill will allow today's student to make better use of the technology at their disposal. According to Johnson and Onwuegbuzie, "knowledge is defined as both constructed and based on the reality of the world we experience and live in" (Johnson & Onwuegbuzie, 2004). By students and educators applying the skill to assess the

personal and academic potential use of these devices, it allows the expansion of the knowledge base of their potential use.

Papert stated that the one competitive skill that is needed in the workplace is the ability to learn to make the correct response in a given situation. He further states, "We need to produce people who know how to act when they're faced with situations for which they were not specifically prepared" (Papert, 1998). Our world has become smaller with the introduction of mobile technology—specifically smartphones that allow the user to communicate, gather and share information from anywhere at any time. Fels, Samers, & Robertson (2003) commented that the advances in information and communication technology (ICT) have radically changed how people communicate. Smartphones are an example of a technological device that requires students to be able to apply Papert's described skill so as to assess and utilize how this technology can be effective as a learning tool both in and out of the classroom.

Herrington, Mantei, Olney & Ferry (2009) discuss how society is moving away from desktop computers to more mobile devices. These compact multifunctional mobile devices move the user towards a device that could fit into one's pocket rather than relying on the power of a desktop or laptop. Furthermore, Herrington et .al state that "the growth and use of mobile devices have overtaken the proliferation of personal computers in modern professional and social contexts" (2009, p. 1). The marketing research firm, Catlys (2012) reported in 2011 that worldwide smartphone shipments increased by 62.7% from 2010. It also reported there was only 14.8% growth in PC sales (pads, netbooks, notebooks and desktops) compared to 2010. The significance with these findings is further described in the report as:

> Smart phone shipments overtaking those of client PCs should be seen as a significant milestone. In the space of a few years, smart phones have grown from

> being a niche product segment at the high-end of the mobile phone market to becoming a truly mass-market proposition. The greater availability of smart phones at lower price points has helped tremendously, but there has been a driving trend of increasing consumer appetite for Internet browsing, content consumption and engaging with apps and services on mobile devices.

Poslad (2009) describes mobile technology as a broad term that refers to "communicators, multimedia entertainment and business processing devices designed to be transported by their human owners." "Smartphones" as they are now called, have emerged as a new class of mobile phones that offers more advanced computing and connectivity abilities with the benefit of various multimedia features such as audio, video and still camera recording capabilities. Litchfield (2010) referred to the perpetually evolving smartphones that have the benefit of expanding uses through the addition of apps that can be downloaded and launched. From these definitions, smartphones predominately differ from mobile technology in their ability to expand their uses from apps as well as Internet capabilities. The evolution of these devices into integrated units, have permeated today's society as an integral communication tool due to their multi-task abilities and powerful processing ability. Examples of smartphones include such devices as BlackBerries, iPhones, Android and other portable communication integrated devices. By embedding information in digital packets that are transported from one device to another, a student's ability to access this ever expanding information make the smartphone an important learning tool.

As young people develop the skills needed to operate mobile devices, smartphones have become an integral part of teenagers' lives. According to Statistics Canada (2005), by grade eleven, 36% of teenagers own a wireless phone with 56% of them having text a messaging

capacity. Of the respondents, 44% reported having Internet access with their devices and 25% said their phone had a camera feature (Office of Consumer Affairs (Canada), 2011). A Canadian Wireless Telecommunications Association's 2008 study reported by Canadian Newswire, showed an overall increase in the adoption of the devices with 72% of Canadians owning a mobile phone. This trend increases with age in the teenage segment with 30% of 13 to 15 year olds and 66% of 16 to 17 year olds owning one (Canadian Newswire , 2008). With this increase in smartphone adoption by teenagers, the importance of its role also increases. A 30 Hour Famine study, conducted online in 2011 by the Harris Interactive, found only 9% of the teenagers polled were willing to go 24 hours without their cellular phone and 80% use social media such as Facebook and Twitter (Harris Interactive, 2011). The United Kingdom's regulator of communications reported in 2011 that 25% of adults and 50% of teenagers own a smartphone (Ofcam, 2011). A U.S. report by Nelson Company, indicated that 40% of 13-17 year olds own a smartphone and this age group most frequently texts with an average of 3,417 messages each month (Nielson Company, 2011). Texting refers to "the exchange of brief written text messages between fixed-line phone or mobile phone and fixed or portable devices over a network" (Wikipedia, 2012). The ownership of these devices by Americans 12 to 17 years of age has steadily increased. In 2004, the Pew Internet & American Life Project found that 45% of teenagers had a cellular phone. This increased to 62% in 2006 and further climbed to 71% in 2008 (Pew Internet, 2009). With so many young people owning smartphones, it is evident that such devices have the potential of being an effective learning tool.

Although these devices are viewed as an integral part of growing number of people's daily lives, the utilization of these devices for the purpose of education has not been as strongly adopted. Educators do not necessarily use this technology in an appropriate pedagogical manner.

Along with the potential that educators may not know how to use their smartphone as either a learn or teaching tool, there have also been some stories in the news as well as reports that hold the viewpoint that mobile technology is detrimental to the learning environment. Examples of these stories include students filming and electronically posting videos of students and educators, cheating by texting during tests and cyber-bullying (CBC Radio, 2007; Technology, 2005). Secondary students may use mobile technology as essential social tools but they are not necessarily utilizing their smartphones as learning tools. Windham (2007) commented in her article, Confessions of a Podcast Junkie: A Student Perspective, that the presence of iPods is widespread on post secondary campuses, but predominantly for personal uses. Most students reported that prior to university, they had not used their device for learning by such activities as to listening to courses' podcasts. From the previously stated mobile technology and teenager statistics, there is no dispute that smartphones have become an integral part of teenagers' lives. The literature generates the question, what needs to be explored is how and why these devices aid in the learning process. At the post secondary level, there are examples of these devices being effectively used for either learning or teaching such as in the Maag's iPod, uPod? An emerging mobile learning tool in nursing education (2006). Exploration of these devices as a learning or a teaching tool now needs to be explored at the secondary level as well.

Society Wants Tech Skills in School Graduates.

As these devices have grown in their importance and use in today's society, education needs to adopt curriculum to reflect this trend. Various bodies recognize society's demand for high ICT skills. Kitagawa and Watt's (2000) Grassroots Project that was published by the Conference Board of Canada in its case study #34, discusses the need for educators and students to develop skills that "go beyond their use in the school setting." The National Business and

Education Centre (NBEC) collaborated with this project, as its mission is to "help business and education leaders work collaboratively to promote the development of a learning society that will prepare Canada's young people for a changing world." The Conference Board of Canada (2011) recognizes the need for students to take their education and apply it at home and in the community. It recognizes that educators need to demonstrate "thinking outside of the box" and link the curriculum to real world situations. This is also being reflected in curriculum development in Canada and elsewhere. Conferences that focus on ICT integration into the classroom are taking place all over the world: 2010 International Conference on 1-to-1 computing in the Education (2010), ACE2010 (2010), 13th UNESCO-APEID International Conference on Education and World Bank-KERIS High Level Seminar on ICT in Education (2009), e-Learning Regional Conference. Specifically in m-learning, Mobile Technology: The Future of Learning in Your Hands (2005), APAC Mobile Learning Conference (2011), the mLearnCon Mobile Learning Conference & Expo (2012) and IADIS International Conference: Mobile Learning 2012, Berlin, Germany, (2012).

Since various world business organizations as well as employers are looking for mobile technology skills, educators must incorporate these devices as tools in education. As society's needs change so does our curriculum need to evolve to include the new technologies that become important to our daily lives. We need to engage students with more hands on, meaningful learning opportunities that engage learners to explore and adopt these tools so as gain the skills to take into the workforce. According to Cook-Sather (2010), "meaningful" learning opportunities involves a higher level of engagement and interest. As a result there is a more thorough understanding of the content than that provided by more traditional learning activities.

There is a trend in public K-12 education towards recognizing and incorporating this technology into the curriculum. Across Canada, the provincial departments and ministries of education have been implementing the integration of ICT and its skill set in all their curriculum documents, in all subjects and grade levels: E-Learning Ontario (Ontario Ministry of Education, 2010), Alberta Education (Government of Alberta Education, 2011), British Columbia Ministry of Education (British Columbia Ministry of Education, 2010), Saskatchewan Ministry of Education (Saskatchewan Ministry of Education, 1985), Nova Scotia Ministry of Education (Nova Scotia Ministry of Education, 2003)

The New Brunswick Department of Education has been proactive in ICT implementation within the curriculum and classroom. In 2004, it implemented an action-based research project to evaluate the impact of providing dedicated notebook computer access to students and educators. This two-year project led to the successful increase in student engagement and quality of teaching. In this study's conclusions, it recommended that the departments and districts develop a unified vision to recognized technology as a pedagogical tool (Kirby & Morrison, 2007). Due to the project's findings and other jurisdictions research, the Department of Education expanded the project to all New Brunswick districts (New Brunswick Department of Education, 2004).

In 2010, Ontario's Ministry of Education released the revised secondary Technological Studies curriculum that recognizes and incorporates the study of smartphones and other mobile technology and their uses (Ontario Ministry of Education, 2009). This shift has been linked to such governmental views that smartphones "are conduits for information and one of the things we want our students to be is well informed. It's something we should be looking at in our schools" (Maclean's Magazine, 2010).

School Adoption Is Slow, Particularly with New Mobile Technology.

At the local level, the adoption of smartphones as a learning tool in the classroom varies from board to board. Although educators recognize and use computers and the Internet in various subject and grade levels, the newer mobile technology is being greeted with mixed attitudes.

Mixed attitudes on technology in the classroom are not a new issue. For example, when calculators were first introduced to replace slide rulers, the calculators were viewed as potentially weakening students' numeracy skills. Later, this attitude was abandoned as educators adopted this technology. Similarly, various viewpoints have formed due to the examples of misuse of smartphones by students. Likewise, there is confusion about the validity of the roles of smartphones in learning. There are some reports in the media that focus on either the potential disruptive use or distractive manner of smartphones by students of varying ages. In a Maclean's magazine (2010) editorial, "Don't Give Students More Tools of Mass Distraction", it describes smartphones as "tools of mass distraction with students "texting tweeting, surfing and updating your online profile." In the Sun Sentinel newspaper's article, "Smart Phones, Internet help South Florida Students Cheat in New Ways", it reported that smartphones help students cheat by sending mass text messages with answers, taking photographs of tests and sending the images by email to friends who respond with the answers and accessing the Internet to search for answers (McGrory, 2010). Another article, "How Technology can Reinvent how and Where Children Learn," comments about school administers who are worrying mobile devices are eroding literacy skills with textism such as the shorted phrase " CUL8R," appearing in student essays instead of using the correct spelling of words (Lunau, 2012).

New York City Department of Education continues to uphold their ban on cellular phones in the classroom as the devices are perceived as being disruptive and promote cheating and harassment (Broache, 2008). The Waterloo Region District School Board has been introducing policy that recognizes and has opened social networking sites such as Facebook as a learning tool and is now exploring the use of Twitter and other web tools (Carbone, 2011). Mobile devices such as iPads, Playbooks and iPods have been purchased for educators to sign out both at the elementary and secondary school level. The use of smartphones in classrooms varies as the board has left their use at the discretion of each school. Some schools have banned them from the classroom; other schools have "safety zones" for smartphone use while others allow educators to determine their use in the classroom. In 2007 the Toronto District School Board implemented a school wide ban of cellular and smartphones from their schools due to the disruptive and destructive nature these devices have to the learning environment (CBC Radio, 2007). Reports of mobile technology being used to pass notes in class as well as to cheat on tests were given as examples of inappropriate uses of smartphones. These devices were being used to obtain videos and photographs of both students and staff that were later posted on the Internet. However in 2010 the TDSB began to rethink its policy in light of the various debates and research (CBC News, 2010), which led board trustees to lift the ban of these devices in September 2011 (Lunau, 2012).

In 2009, the Near North District School Board initiated an Educator Leadership and Learning Project (TLLP) to enable educators to develop new pedagogical process while capitalizing on the vast number resources that these devices allow. Examples of mobile projects included co-op educators using these devices audio recording capabilities to create voice memos by students, their co-op employers and educators. Another group of educators use the audio

recording function so as to help students who struggle with written responses in other subject areas. Other educators are creating mobile content apps to support students not only reviewing materials but also to be able to learn anywhere (Board, et al., 2010). With the successful use of these devices in Peel District Board classrooms, the school board is investing $7 million from its Working Fund Reserve to cover the costs of placing the infrastructure that will allow students to utilize these devices by providing Wi-Fi services as well as invests in mobile devices for students to use (Canadian Newswire, 2012).

Although the District School Board of Niagara's policy requires students turn off all mobile technology and refrain from using them except in designated areas so to prevent them from interfering with the learning, privacy and safety of students, staff and others (District School Board of Niagara, 2007), there are educators who are exploring their teaching capability. The successful integration of smartphones in his teaching practice has led to Eric Moccio to be recognized and invited to the Apple Distinguished Educator (ADE) program in 2009 (District School Board of Niagara, 2009). Boards of Education are now starting to recognize the value of mobile devices as effective learning tools.

Parents' Opinion

Even though some parents may be using these devices both professionally and personally, their opinions of teenagers using cellular and smartphones are mixed. In the wake of Columbine High School massacre, parents began to ask their children to keep a cellular or smartphone on them at all times for their safety (Katz, 2006). An informal web poll shows that 85% of the 8750 respondents are in favour of cellular phones being allowed, providing that schools control their use and impose limitations during class time (Parent Education, 2011). The

website that conducted this web poll is called Family Education. Pearson Education, other publishers, and education-based companies launched it in September 2000 as a resource for both parents and educators. A Rasmussen poll (2010) reported that 75% of 1000 respondents stated that children spend too much time using electronic devices; 53% believe that "it is bad news that so many kids have cellular phones," but 24% were not sure. In the documentary Condition To Be On Call, interviewed parents comment on their frustrations with their daughter who "never lets go of her smartphone and is always texting her friends" (Mitchinson, 2010).

With the conflicting views in the media as well as the wide range of school policies for smartphones in the classroom, it is understandable that parents also vary in their support or opposition to these devices. Reticence by both parents and school boards suggest that further exploration of the smartphone as a learning tool is needed to determine what constitutes appropriate educational experiences and how best to integrate its use into the school curriculum and expand learning beyond the classroom.

Smartphones are Being Successfully Incorporated in the Learning Process.

In contrast to the negative reports of behaviours or outcomes of secondary students who use smartphones in school, research has indicated that these devices can have an enriching effect on the learning environment. In economically disadvantages regions, mobile technology can provide economical access to the Internet while enriching the learning platform from being limited to only pen and paper. A South African study discussed how mobile technology has allowed students to produce animations, utilize built-in camera functions as well as texting tools while learning (Batchelor & Botha, 2009).

Nursing schools have begun to have students access podcasts of their lectures for review and attendance. A podcast is an audio and/or video recording that is uploaded to a server for the listener/viewer to access and play on his/her mobile device (Maag, 2006). Maag reported that nursing students found this advantageous especially for review while commuting or doing other tasks. Students also appreciated that it allowed them to gain the knowledge when it was not possible to attend the actual lecture (Maag, 2006). Mobile technology is also being used in foreign language learning by allowing students to access vocabulary lists as well as listen and record their pronunciation that can then be shared and critiqued by peers and instructors (Ye, Uru, Akasaka, & Sakamoto, 2009). From isolated applications in various courses and situations, educators have started to accept the view that these devices have given birth to a new digital skill that is allowing our world to become smaller. In Sharples article, The Design of Personal Mobile Technologies for Lifelong Learning (2000) it describes how these devices have created a demand for new digital skills that allows learning to occur anywhere and at any time that there is a break in a person's routine.

Problem of Interest

After examining the literature and various opinions on the topic of m-learning and the role of smartphones in education, it is not surprising the amount of conflicting policies and views that surround these devices. Educators either believe that smartphones have a positive impact on education or view them as a distraction. Teenagers generally view these devices being "personal" and therefore are seen for personal and not educational use. The policy makers are conflicted due to the negative viewpoints that these devices are more of a classroom and learning hindrance than as a useful tool. As these devices are relatively new, having been introduced in 1992 (Wikipedia, 2012), m-learning curriculum is still in its early development. Secondary

technological studies educators have always had to adapt their curriculum to reflect the changes in technology. What cannot be ignored is the important role that smartphones hold in society and the need for the curriculum and policy to be developed around it for all secondary subject areas. ICT technologies, specifically smartphones, are an area of technology that needs to be incorporated in secondary school pedagogical practice. The need for today's learner to develop the skill to adapt their learning to societal needs is one of the most important skills necessary. Inadvertently, the main question for this study was how can smartphones be successfully incorporated and adopted as either a learning or teaching tool at the secondary level by both educators and students?

Theoretical Framework

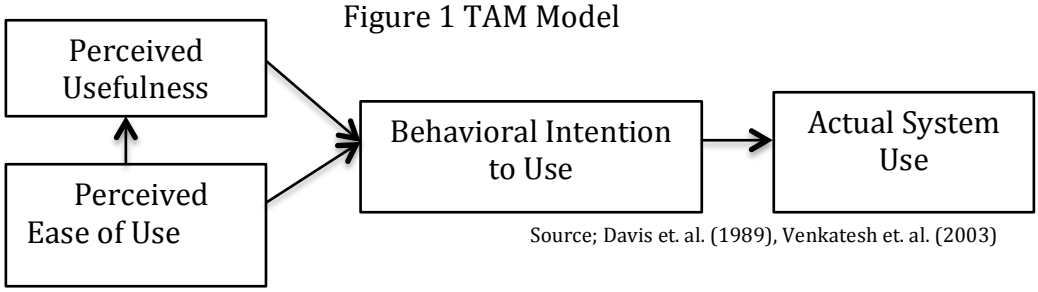
In order for the successful adoption of smartphones by learners and educators at the secondary level, it is important to examine the various theories that address the issues that influence the level of success for the adoption of technology. The following theories have been chosen as they address the issues that have arose with various technological adoptions both generally and by the parties involved in education. These theories help with the successful policy development for implementation of technological adoption as they examine the attitudes as well as the influencing factors.

TAM Model

Although there is a presence of smartphones in the secondary classroom, they are not necessarily being utilized for learning. The problem lies in the view of their perceived usefulness by both educators and learners alike. In examining theories that address the potential issue of technology adoption, the TAM model, as shown below in figure 1, examines the effect

of the perceived usefulness of technology on its successful adoption. Designed in 1989 as predominantly a business model, Fred Davies developed the technological acceptance model (TAM) that proposed three factors in user motivation: perceived usefulness, perceived ease of use, and attitude towards using. These factors would dictate the level of success for actual system use (Chuttur, 2009). This model addressed the issue that regardless of the technological advancements in hardware and software, one of the biggest challenges is underutilization of these systems and therefore the underutilization of the device.

Figure 1 TAM Model

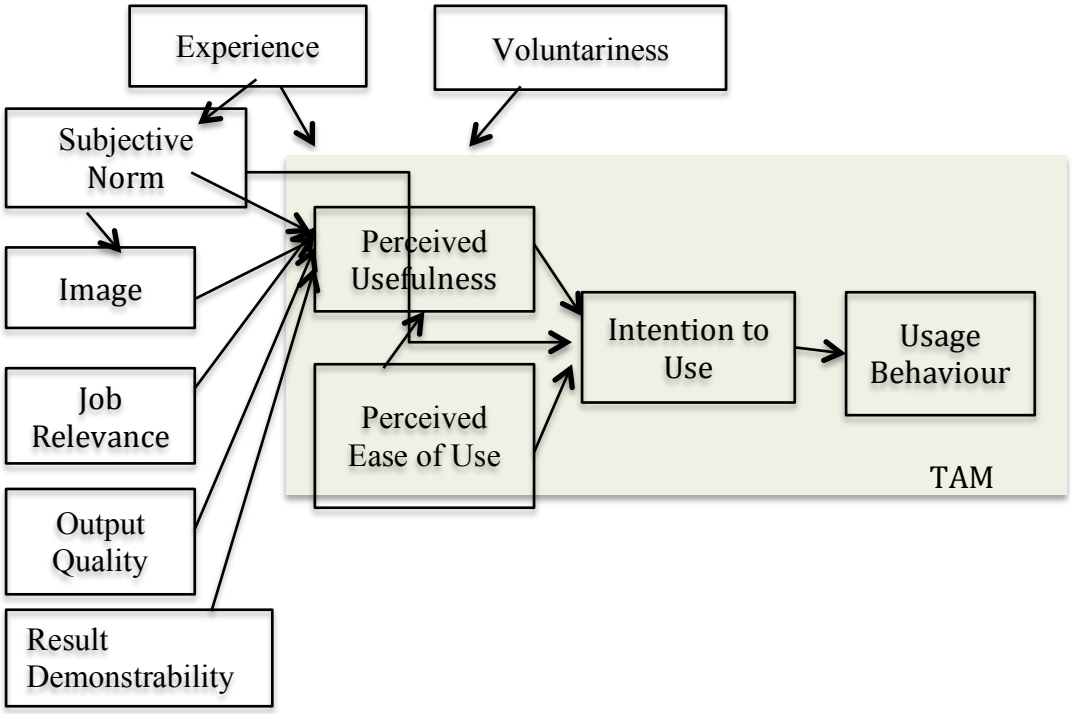


Source; Davis et. al. (1989), Venkatesh et. al. (2003)

TAM2 Model

What is lacking with the TAM model is the importance of other influencing factors for both teenagers and educators beyond the technology itself. In 2003, Venkatesh and Davies expanded this model to what is referred to as TAM2, as shown in figure 2 on page 8. They expanded the influential factors to also incorporate additional theoretical constructs: social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use). The TAM2 model illustrates how, if the learner or the educator does not perceive mobile technology as relevant in all of the model's aspects, voluntary use is not likely not to occur (Venkatesh & Davis, 2000). Sequentially if the smartphone is to become an integral part of the learning environment, it is important that these elements be address in any curriculum.

Figure 2 TAM 2 Model

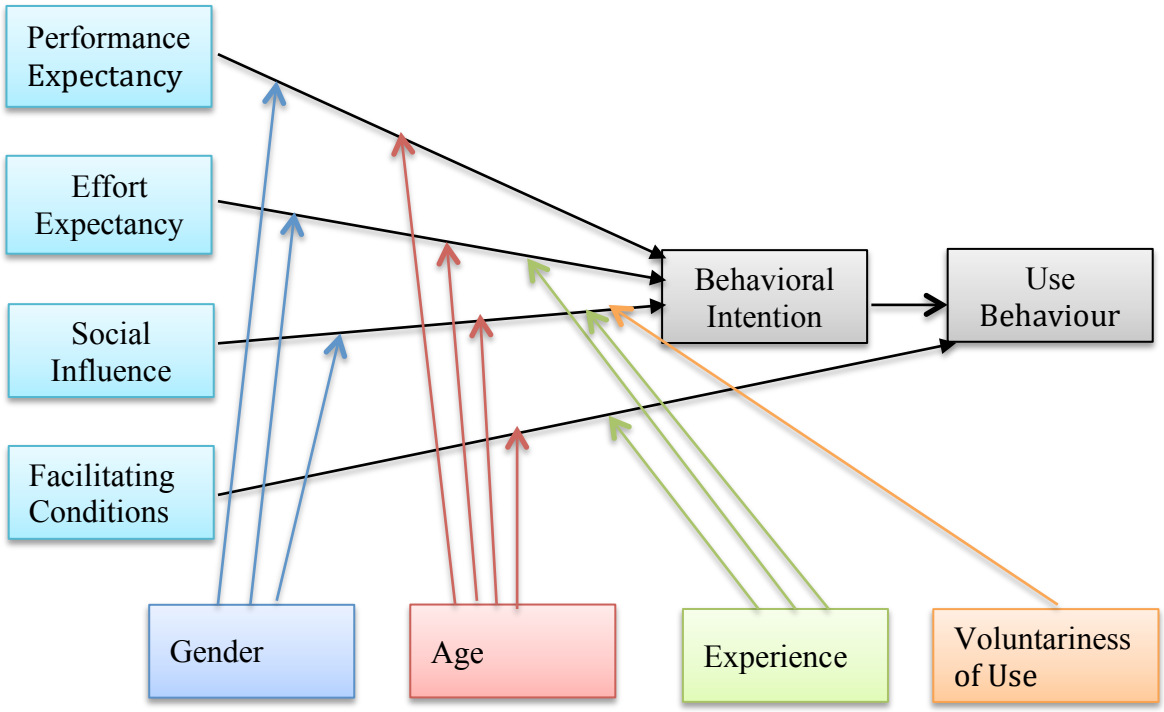


(Roso, 2009)

TRA Model

Addressing the attitude towards mobile technology's adoption, the theory of reasoned action (TRA), as shown on page 23 in figure 3, specifically states that an individual's positive or negative belief directly affects his/her behaviour and action (Fishbein & Chaiken, 1993). If educators continue to see smartphones as either a distraction or a classroom management issue and teenagers continue to see smartphones as a personal social tool, then the likelihood of widespread use as a learning tool is greatly diminished.

Figure 3 TRA Model

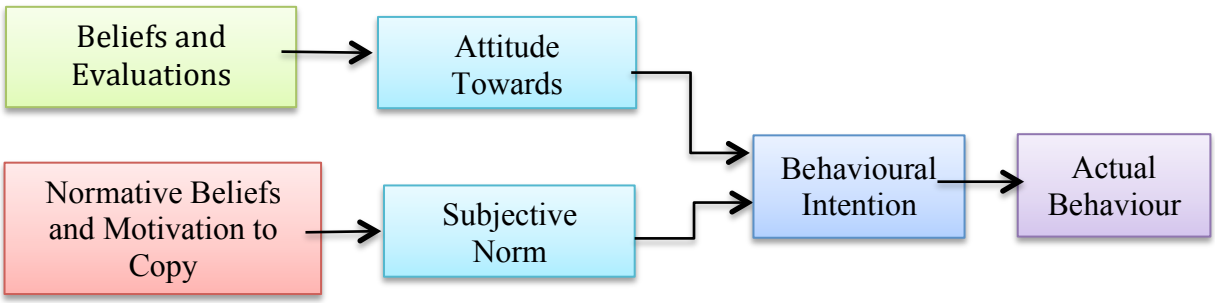


(Legris, Ingham, & Collerette, 2003)

U TAUT Model

The 2003 UTAUT model addresses four main areas of construct that are directly impacted by gender, age, experience and voluntariness of use for technological acceptance for both the learner and the educator. As show below in figure 4, the unified theory of acceptance and use of technology (UTAUT) model explains the influential factors of user intentions in regard to ICT and usage (Venkatesh, Morris, Davis, & Davis, 2003).

Figure 4 UTAUT Model

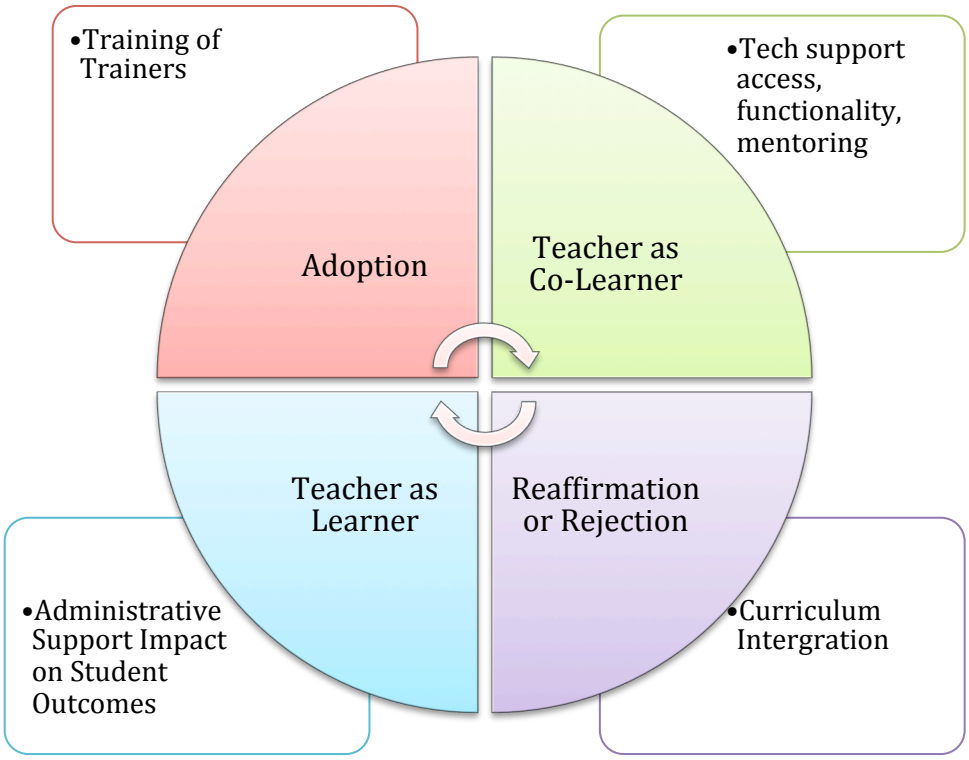


(Wade & Schneberger, 2005)

Integrated Technology Adoption and Diffusion Model

Specifically addressing educators' challenges with technology adoption is the Integrated Technology Adoption and Diffusion Model. This model as shown below in figure 5, recognizes fourth distinct stages as an educator develops his/her expertise with the World Wide Web. This model can be applied to the adoption of any technology in education. It recognizes in the forth stage after skill development and curriculum integration, that educators will either adopt or reject the technology depending on the level of its success (Sherry, Billig, Tavalin, & Gibson, 2000). This model demonstrates that no technology, including smartphones, will be adopted without a supportive network that can address any technical or curricular issues as they arise. The successful adoption of policy and technology requires that the correct resources be put in place before adoption is introduced.

Figure 5: Integrated Technology Adoption and Diffusion Model



(Legris, Ingham, & Legris, Why do people use information technology? A critical review of the technology acceptance model, 2003)

The Development of a New Model

All five of the models demonstrate the importance of the user's representational value and openness in order for the successful adoption of technology. Whereas the TAM model is more applicable to educators whose adoption of technology is reliant on the relevance towards the job and therefore towards the educator's teaching practice, the TAM2 model addresses other influential factors that affect teenagers' adoption of technology. The UTAUT is more relevant for the secondary learner as it recognizes the importance of peer acceptance, potential gender issues and openness towards adoption in order for adoption to take place. The TRA model suggests that desire must be present in order the successful adoption to take place—this is relevant to both teenagers and educators. Integrated Technology Adoption and Diffusion Model outlines the role of administrative and support staff for the professional development of technology as a learning/teaching tool.

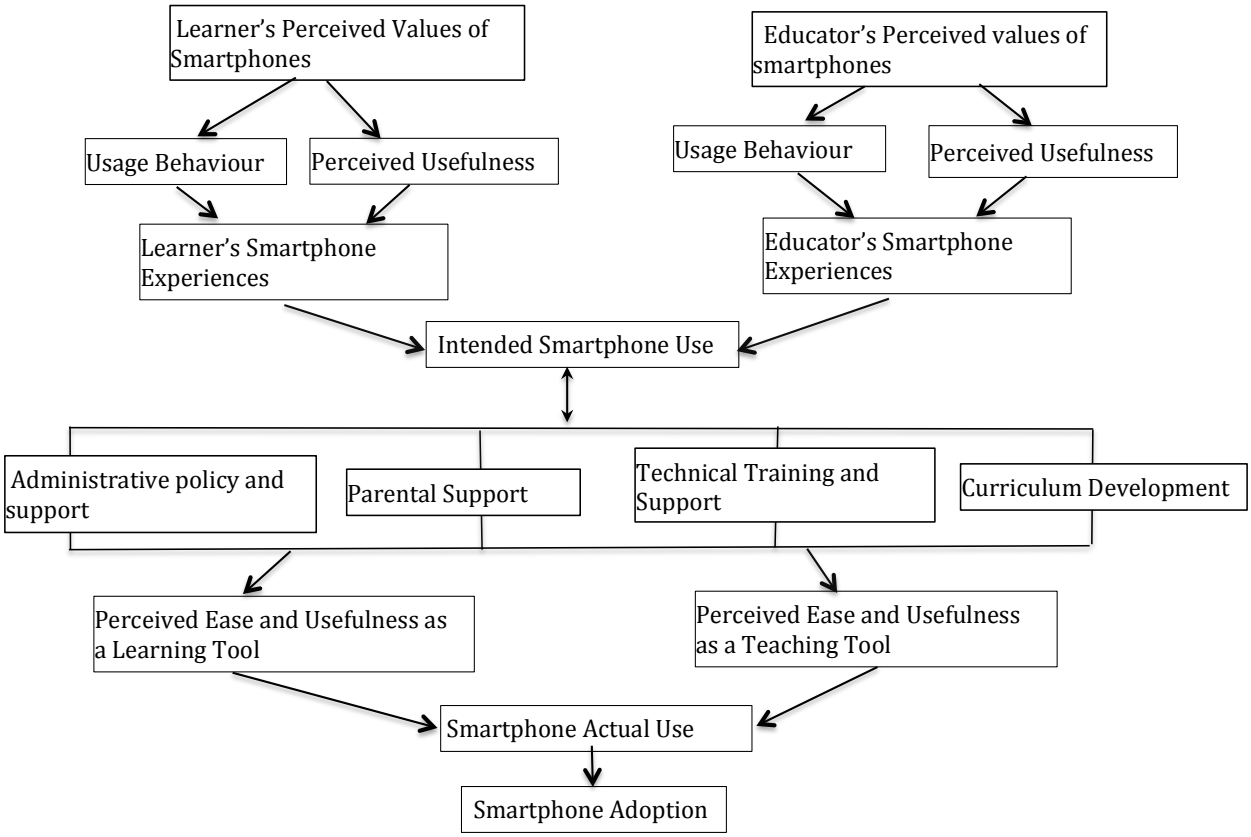
M-Learning Acceptance and Adoption Theory Module (M-LAAT)

Emerging from all of these models is a need for a theory that recognizes not only influential factors but also the necessary support network. It is the support network that provides the policy and encouragement, along with the knowledge and technical support to enable both the learner and the educator to harness the tools and capabilities of the smartphone so that it is successfully integrated into education as a learning tool that will engage students in learning.

From both the learners' and educators' perceptions, this model represents the factors that affect the successful adoption of smartphones for m-learning. The M-LAAT module addresses the need to recognize the perceived values of smartphones by both the educator and learner. It also recognizes that smartphones have the ability to have either a positive or negative impact on teaching and learning. Because these devices often evoke an immediate response to peers and can be used in a detrimental manner, it is important that training is provided for both the student and the educator alike. Smartphones may be a relatively new device that an educator needs to explore as a teaching tool, but the acceptance and support must come from parents and administrators first.

As shown in figure 6 on page 27, the M-LAAT model demonstrates that learners and educators must examine individually how and why they use smartphones before identifying any experience using smartphones for learning or teaching. By examining the potential uses of the smartphone's features and apps, these experiences will establish the intended use of the device for learning. By identifying the various ways that a smartphone's features can be used to facilitate learning, it creates the smartphone and its apps into a learning tool. So that learning opportunities can be developed, it is essential that the necessary support network be in place. Parents need to support their child's use of his/her smartphone and administrators must develop meaningful user policy and procedures so that these devices can be harnessed as a learning tool. With the administrative support for the use of smartphones in teaching, the development by both educators and the various governing bodies of subject specific curriculum as well as technical support within the schools, it will simplify the implementation.

Figure 6 M-LAAT Model



(Flood, Figure 6: M-LAAT Model, 2012)

Study Questions

Recognizing the various influential factors in smartphone adoption and acceptance as a learning tool, the main question for this study is: What affordances do smartphones offer as a learning tool in the secondary school technological classroom and how can it extend the learning environment and activity outside of the classroom?

Study Questions Formed From Literature Reading

Even though most of the literature is in favour of the use of smartphones as both a learning and teaching tool, the views vary between academic bodies, parental organizations and the media. This could be linked to the lack of experience of these devices for educational purposes. The views of smartphones between these bodies is constantly changing; in the time that this paper was written there were three Ontario school boards that changed their policy in regard to the use of smartphones in the classroom. From these opinions, the following questions were formulated:

- What representational values do secondary students have of smartphones as a learning tool and ease of use?
- What representational values do educators attached to smartphones as a learning tool and its ease of use?
- How does that student's perception change with a problem based learning activity using smartphones?
- How has my "representational value" of the potential use of this technology changed throughout this experiment: The intentional use is different, the perceived use is different.
- If we put a study in a school, can I act on perceived use and then see if students and educator see any perceived value-- pre and post learning activity?

Method

In order to streamline and maximize the results and validity of the study's findings, a logical procession of steps was created as shown in Table 1 on page 29 and 30. The steps were designed to meet all necessary timelines and requirements of the participating parties. This was especially important since key participants were technological studies high school students and the logical concern about coercion and the violation of their rights as minors. It was important for the researcher to understand and follow the application process with the various ethic committees, participants and their parents so that the study could be conducted in an ethical and valid manner for it to be considered for peer reviewed.

In order to provide as broad a reference as possible, a mixed methodology was used to collect and view data from the participants in order to produce a more thorough examination of the results. As defined by Johnson and Onwueghbuzie (2004), "mixed methods research is formally defined here as "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study." Its advantage is it offers a "broader level knowledge gained due to varied approach. This approach is viewed as producing a superior product compared to mono-method studies". For this study, knowledge is defined as both "constructed and based on the reality of the world we experience and live in" (Johnson & Onwuegbuzie, 2004).

Table 1: Research Study Design Steps

Step	
1	Source ideas
2	Literature review
3	Formulate study questions
4	Design data gathering instruments

5	Design study activity to utilize smartphone technology while meeting Ontario Ministry of Education's curriculum expectations
6	Gain permission from appropriate ethics committees—both university and school board.
7	Contact and gain permission from the participating communication technology educator and Administration.
8	Gain parental and student permission to participate in the study and treatment.
9	Study: Treatment Procedures • Assessment of Current Technology Availability • Treatment Explanation • Research Project Submission
10	Gather data • Qualitative Pre-Activity On-line Survey • Quantitative Pre-Activity Focus Group • Quantitative Post Activity Focus Group
11	Interpret data
12	Report results

Designing and Accessing Data Gathering Instruments

In order to provide a comprehensive perspective of the participants' views and uses of smartphones, both qualitative and quantitative data gathering methods were chosen. A survey (Desjardins & Bullock, 2012) was conducted on-line to gather a basic profile of the students' use of technology along four dimensions: technical, communication, informational and computational use. By having the students complete this survey, a better understanding of their access to smartphones, as well as a measurement of their level of knowledge and comfort with smartphones and other ICT technologies was achieved and in doing so gain the students' smartphone experiences as outlined in the M_LAAT model. By gaining a better understanding of the levels of use, comfort and knowledge of the technology of the participants, this knowledge can be applied for future curriculum, support and policy development. After completing the quantitative portion of the pre-study activity, the students and educators then participated in the

qualitative activity that took place as a focus group discussion to establish their views on the validity, challenges and current uses of smartphones. This discussion gave further insight about the students and educators' current uses as well as their views on the challenges and advantages that these devices bring to learning in the classroom. Another focus group discussion was conducted at the conclusion of the study so as to compare any shifts in the participants' views, beliefs and future uses of smartphones.

Design Study Activity to Utilize Smartphone Technology While Meeting Curriculum Expectations

The treatment was carefully designed to meet a variety of curriculum expectations for Ontario grade 10 and 11 communication technology courses (TGJ 2OI and TGJ 3MI). Choosing to meet live production requirements under television broadcasting, students were to create their television broadcasting segment assignment. Whereas traditionally students used a classroom desktop computer to conduct research on their topic and a video camera to shoot their footage on location, students were able to complete all research and shooting on location using free Wi-Fi and their smartphone's browser. Note gathering could also be completed and shared from their smartphone's text editor and their footage could be shot with their build-in camera.

While meeting their broadcasting unit requirements, students were able to explore alternative communication techniques utilized in the broadcasting industry such as website video sharing from various sources. Students also learned problem solving, time management, morality issues, changes in ICT and broadcasting industry standards and expectations. The additional advantage of limiting the students to completing their assignment with their

smartphone was that the lack of additional equipment helped them meet the specified timeline for the assignment's completion.

Study's Primary Participants

The primary participants of this study were junior and senior communication technology students at a secondary school as well as their educators. This study was to explore the views and use of mobile technology of technological studies students as a whole without differentiating between male and female students. The students were between the ages of 15 to 18 years of age.

Appropriate Permission From the Necessary Governing Bodies—Both at the University and School Board Level

Getting permission of the necessary governing bodies and participants was essential so that the study could be conducted in the proper and ethical manner expected for a graduate study paper. Both the Waterloo Region District School Board Research Committee and UOIT's Research Ethics Board were approach simultaneously. The Waterloo Region District School Board required that all permission forms from the G.R.C.I. students be collected for the researcher and held in storage until after the end of the semester so as to maintain the anonymity of the participants so that students did not feel cohered to participate as the researcher was also the course educator. Conditional approval was granted upon the other committee's approval. The ethics committees were informed of the conditional approval so that their approval could be moved to being unconditional.

Contact and Gain Permission From Participating Communication Technology Educator and Administration

After obtaining permission from both UOIT's Research Ethics Board and the Waterloo Region District School Board Research Committee, potential communication technology classroom educators were approached to participate in this study. Permission by the school principal for the participation by the educator was given under the condition that the study's treatment would be recognized as a school sanctioned field trip. In order to obtain the permission of the participating classroom educator, planning had to take into consideration the course's timeline so that it could meet semester deadlines.

Although initially my study required students leave the school property independently to do their assignment, this was not acceptable to all administrators. Some administrators were worried, from a liability issue, of allowing students to leave the school property on an unsupervised school event and required that the educator accompany the students on their walk, remain within a close proximity of where the students were working and accompany them back to the school. At the other school, the grade 10 class could leave the school's property on their lunch period as long as they returned by the end of it. The grade 11 class was allowed to leave the school property during class time on the condition that they returned to school in time for their other classes. Understanding the liabilities issues that come with teaching minors, does it pose the question of how we can allow students to learn independently outside the formal classroom during regular school hours? Providing students with in-school time to learn these skills will encourage the building of this activity and skills to continue learning outside of the formal school day.

Permission Gained From Participants and Their Parents

Because most of the participants were minors, permission was obtained from both the participants and their parents. The students were allowed to participate in all aspect of the study's activities but also that the grade 11 students were allowed to leave the school campus as a school sanctioned field trip. By listing this activity as a field trip it also indicates that the students were willing participants in the activity and the parents supported it.

Activity Procedures

Assessment of Current Technology Availability

In order to accommodate any students who did not possess a smart device with Internet access, students were to work in pairs. Utilizing only their smartphones, students were required to access a course project's instructions, conduct primary and secondary research to complete this project and communicate with the instructor by IMS (instant message service), social media websites and phone. Students utilized the video function of their mobile technology to do the video recording for their project. Students were allowed to use any other function of their smartphone, but they were cautioned to meet all of the project's deadlines.

Assignment Explanation

Before leaving the classroom, an explanation was given to the students on how they were to access their broadcasting assignment's requirements through their smartphone. Samples of the project's resources are located in the appendices on page 72. The students' assignment was outlined in a video that the educators created using their own smartphone and then posted on two

video hosting sites (Vimeo and YouTube) as well as the course's Edmodo page. Multiple sites were chosen in case any of the sites went off line or were blocked through firewalls. Students were reminded to use the list of newsgathering and information websites created by the class on a whiteboard during a class exercise. Students were required to record this list with their smartphone's camera or to obtain a copy of the list's image. They were also given a list of locations where they could find free Wi-Fi both on and off of the school property. The educator offered, but none of the students indicated that they needed help to use any of their smartphone's features.

Students were given a detailed explanation on how to conduct themselves as professional broadcasters as well as good school citizens. The students were then told to limit their travel to a distance that would allow them to return to the school or rendezvous point on time. Problem solving ideas were also presented to students in the event that had difficulty finding people to interview or researching their topic in order to successfully complete their project's requirements. Students were reminded that, as in industry, if they had any questions, they were to contact their educator using their smartphone who would be acting as their station's producer. It was further explained that their personal safety was paramount and if they had any questions or needed assistance, they were to contact their educator immediately.

Assignment Submission

Initially the students were to upload their assignment remotely while on location to a media hosting website such as Vimeo or YouTube. This idea was later abandoned due to concerns with students' privacy and the U.S. Patriot Act, as the websites are American based. The Patriot Act, was introduced post 9/11 allowing federal officials the right to intercept and

track all communications for the purpose of law enforcement and foreign intelligence gathering (Answers, 2004). This contravenes with various Canadian provinces' privacy laws that protect citizens (including minors) from the gathering and storing of personal information without consent. As discussed at an Ontario government's 2006 workshop, the issue becomes how can a Canadian's privacy be maintained with utilizing websites that transfers data to U.S. servers (Robinson & Douglas, 2006). Because of the conflicting laws between Canada and the U.S., it was recommended that students upload their videos directly to an encrypted hard drive instead. When the students returned to their classroom, a computer station was set up for students to plug their smartphone's cable into the computer so as to off load their video to a specified group folder on the encrypted hard drive. In the future, a secured classroom cloud device such as Western Digital's My BookLive may be used since it can be accessed remotely and still serve as a repository for all of the data.

Data Gathered

Qualitative and Quantitative Data

At the completion of the treatment and data collection, both the quantitative and qualitative data were analyzed to decide how successful this technology could be used to expand the learning environment so as to answer all of the study's questions. The representational values of smartphones prior to the study's treatment were examined for both the educators and learners through a qualitative survey and quantitative reflective journaling, and focus groups.

During and immediately following the completion and submission of the students' broadcasting project, the researcher, who was the participants' educator, was to document the experience including her opinion of the success of the activity. The educator from K.C.I. was

questioned directly on his experiences with smartphones as well as on any shifts that was occurring during the activity. His reactions to his students working on location were also observed. Upon returning to the school, the students were to participate in a recorded focus group discussion. The results of the pre and post treatment were compared for any shift in perceptional values on smartphones and their role as learning and teaching tools. These results were weighed against the level of successful completion of the outlined broadcasting project's requirements. A copy of the assignment's rubric can be seen on page 72. The educators reflected on his/her perception of the success of the activity as well as any shift in perceptional value of smartphones.

Pre-activity Data Gathering

Prior to involvement in the broadcasting project, the communication technology students participated in both qualitative and quantitative research.

Quantitative On-Line Questionnaire

Students were given an on-line questionnaire to inquire on their representational values of smartphones both in and out of the classroom. The on-line questionnaire predominately utilized Likert scale questions so as to evaluate the level of understanding and usage with mobile technology. The results from this questionnaire were analyzed for any trends or unique observations or beliefs that become apparent when reading the level of results from each question.

Qualitative Focus Group

Students were asked questions in a video and audio recorded focus group using a standard video camcorder and Livescribe pen so that their qualitative responses could be analyzed. The participating educators also kept a journal of personal values and beliefs as well as qualitative observations of the participating students throughout this study so as to identify any shifts (beliefs or values).

The questionnaire section focused on the participants' use of smartphones, to give a more detailed understanding of the primary and secondary purpose of these devices. A qualitative study was also conducted at this time in the form of a focus group. A series of pre-established questions were asked to gather information in regard to the students' representational value of the role of smartphones in their education. These results were compared with previous reports such as Windham's study (Windham, 2007) that recognized students' initial representational value of these devices being primarily for social and entertainment purposes. By comparing this study's results with current literature and the experiences outlined in the M-LAAT model, it aided in answering this study's question of what affordances does a secondary technical studies student prefer and need to adopt to effectively scaffold learning with smartphones.

Qualitative Data Method

Since school policy requires the presence of an educator, this activity afforded the opportunity to observe and report student behavior. During the assignment's activity qualitative data was gained through the researcher observing both the students and the educator's reactions to the various challenges that occurred as well as when the researcher was conducting the study with her own students. Empirical research refers to knowledge gained through observation

(Oxford Dictionaries, 2012). The opportunity presented itself for the educator and researcher to observe the students working on their assignment, as school policy required that an educator be present during the activity.

Post-Activity Quantitative Focus Group

After returning to the school, students participated in a focus group where they discussed their experience of the treatment--specifically their level of stress, ease of completion and knowledge expansion through m-learning. These results were cross examined for commonalities as well unique observations with each of the participants as well as compared to the results stated in such Sydney University 2006 study on iPod uses in nursing education (Maag, 2006).

Results

The study's data was analyzed in three different ways. The results of qualitative and quantitative data were first compared for similarities and discrepancies. The data was then compared to the literature to see if the findings were consistent with the peer-reviewed literature. Finally, a comparative analysis was done on the pre and post treatment's quantitative and qualitative results to observe if there was any shift in the views of the students and educators.

In this study there were 41 participants: 19 females and 22 males. These participants were students from three communication technology classes from two secondary schools: There was one grade 11 class from Kitchener Collegiate Institute (referred to from this point as K.C.I.) and a grade 10 and grade 11 class from Grand River Collegiate (further referred to as G.R.C.I.) in Kitchener, Ontario.

The students at K.C.I. were required to report to their classroom prior to leaving to conduct their broadcasting project. Upon their arrival to their classroom, students were asked to complete an on-line survey on their access to and uses of technology. The students began completing their survey while waiting for the arrival of the other participants. This approach was used because the school's administration required the students to leave school property collectively under the direct supervision of the their instructor. Six out of the ten students indicated that they could not play the video on their smartphone due to personal account bandwidth and access to stable free Wi-Fi issues.

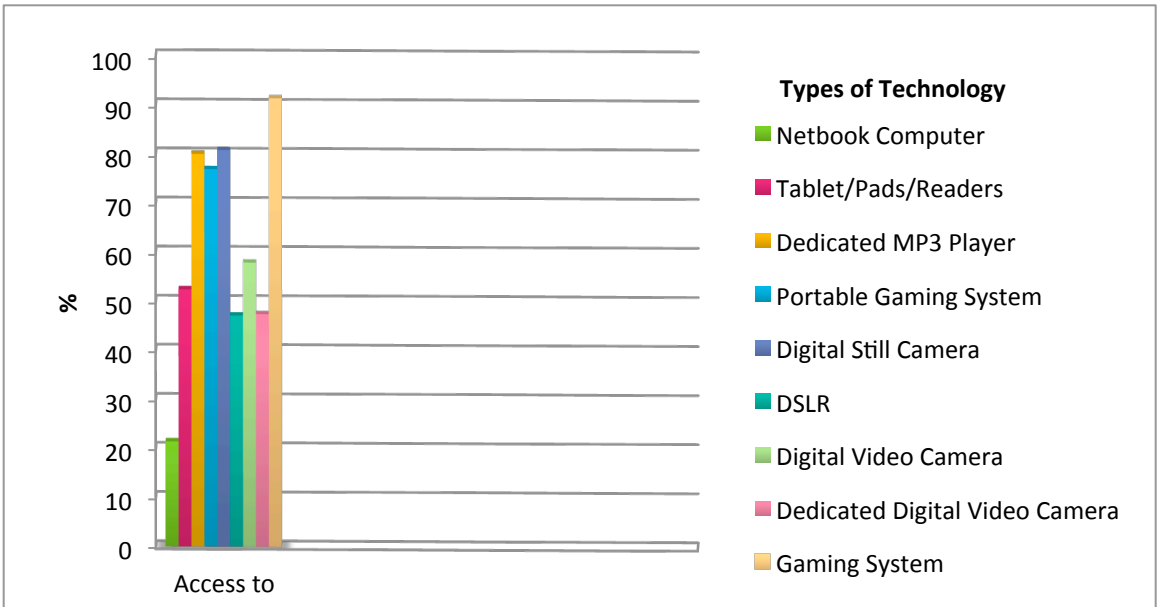
At G.R.C.I., the students were given the choice of either remotely contacting their educator for attendance or reporting directly to the classroom to complete the survey. Only four students chose to initially communicate their attendance and access the assignment using their smartphone while the remaining 27 students preferred to work in the classroom using a desktop computer to access the assignment's requirements. During the focus group when inquired why they chose to use this device instead of their smartphone, some of reasons given were that they preferred the larger screen, that they did not want to use their data plan and/or that it was easier to access due to signal strength in the classroom.

The results from the qualitative study indicated that the majority of these students (33) own or have access to a smartphone. While this research indicates a higher discrepancy between the previously mentioned UK (Ofcam, 2011) and U.S. (Nielson Company, 2011) findings, it does not attribute to why this has occurred. It does show that the adoption rate of smartphones is continually increasing.

Although there was not any literature at the time of this project's completion, to address the differences of the amount of students who own or have access to a smartphone, it could be possible due the rapidly increasing adoption rate of these devices by teenagers. Twenty six of the participants indicated that they own to at least one cellular phone without a data plan and 16 students indicated that they only have access to one. From the group discussion, some students indicated that they had borrowed their parents' smartphone that was initially purchased for work. The students indicated that they were allowed to borrow these devices for specific purposes—in this instance it was to participate in a school assignment. Another reason why students were allowed to borrow these devices was due to personal security reasons if they were going out with friends. One of these students did own cellular phone but without a data plan while another did not possess any mobile device due to cost.

From the quantitative study, the most important alternative devices include gaming systems such Play Station and dedicated MP3. The demand for smartphones by teenagers is understandable when examining alternative devices that they view as most important. Smartphones provides a single device that offers all of these features.

Figure 7: Most Important Alternative Devices



Pre-activity Focus Group Results

Smartphones and their Uses for Students

During the pre-activity focus group, students commented that the most important device that they owned was a smartphone, which eliminated the need for such objects as an alarm clock, calculator, camera, dedicated portable music player, gaming systems or even a flash light. They enjoyed its multi-functionality as well as its ability to allow them to remain in contact with their peers whenever they wanted.

There was also a great deal of discussion in regard to the variety and usability of apps that are available for smartphones. The list of preferred apps, their functionality and benefits grew as the discussion by the participants progressed.

Students spoke of fitness apps (e.g. Nike Fitness) that they both use personally and in some of the physical education classes. Other examples of apps including multimedia-editing apps (e.g. Photoshop, iMovie and Garage Band) were identified as being predominately for personal use but were also used for educational purposes as well. Some of the students discussed educational apps that teach or enforce various curriculum-based concepts in a variety of subjects and grade levels. One student commented that it helped her prepare for an anatomy test. There were some web-based apps that students were also using solely for educational purposes (e.g. Edmodo) that allowed their educators to push information such as assignments and marks while allowing students to contact their educator outside of class time. Students also use their web browser for gathering information using such websites as Google and Wikipedia as well as using on line dictionaries. Some of the students also checked the weather, read news articles and

electronic books. Students also commented that their smartphones allowed them to stream educational or how-to videos and read articles that assisted with homework completion.

The students enjoyed passing their devices to each other as they discussed the merits of their preferred apps as well each one's functionality. As one student would present an app to the group, it was observed that students who saw a benefit with the app would download it instantly. One frustration that was also stated was the unequal availability of apps between devices. The point most commonly made was that iPhones have more apps available than android and BlackBerries. Apple Canada reports that there are over 500,000 apps available on iTunes (Apple Canada, 2012) versus 450,000 for android apps (Agular, 2012) and 60,000 BlackBerry devices (CrackBerry, 2012).

When discussing how they preferred to communicate with their devices, it was unanimous that students prefer to "text over talk." Students commented that texting was less confrontational especially when having a difficult conversation with a peer as it allows a person to consider his or her response before sending it and not having to the person's emotional reaction. Texting also allowed for more privacy. This was observed during the discussion as some students were having back channel conversations with each other through texting. At times they would look up from their devices to continue the conversation directly with the group, but other points were only shared with certain individuals. Even during face-to-face conversations, teenagers will text a point that they feel is more private. When asked how they felt when others chose to back channel, the comments were primarily feeling isolated and excluded. Along with private conversations, the participants commented on one of the most used apps was Twitter that would allow them to update their followers with 140 character "tweets." Along with the convenience of not having to direct their messages to particular

individuals, it was also noted that there was a degree of ego building/bravado with this app, as students like to post tweeting milestones such as the number of tweets and followers. This re-enforces the belief by teenagers that their smartphones allow them to remain constantly connected to their peers. Students shared other ways that they use their devices as a means of connecting rather than face-to-face communication. An example given is the posted tweet listed below from a 15 year student: "@NotesForGirlz: Our generation doesn't ring the doorbell ... we text or call to say we're outside." -Soo True RT (McDonald, 2012). The choice of texting versus ringing a doorbell is not seen as good etiquette rather the preferred form of communication.

Most interestingly was a comment by one grade 11 student who said that smartphones "can be more useful as they are always running and with dual core, they are as useful as a netbook" (1, 2011).

Being connected did not always elicit positive comments. Some of the negative aspects of their devices include students who refrain from putting their smartphones on silent mode and consequently disrupt classes. They also commented that even on silent mode, the vibration of their ringing devices on desks could be a disruption as well. This generation has become so accustomed to being in constant contact with their peers; they feel obligated to respond immediately during class, family time or in the middle of the night. This last point reinforces Mitchinson's point of teenagers feeling obligated to always be ready to answer at any time (Mitchinson, 2010). Along with texting, students admitted to or have witnessed people playing games and checking their Facebook status during class or at work with their smartphone as well. This has led to discipline issues. Cyber-bullying, where students use their device to send threatening or derogatory texts or social networking posts, is another issue that students have experience or know someone who has been a victim. Participants also spoke of witnessing

students cheating on tests with their smartphone, but they also said that it has not necessarily increased cheating, just the method to do so.

Students commented that their mobile devices were also perceived as status symbols. An informal poll showed that the majority of the participants (31) changed their smartphone at least once a year for "a better model that offered more features." The students who were using an older cellular phone, used an apologetic or embarrassed manner to describe their phone, as well as expressing a strong desire to obtain a smartphone. The students commented that their phone was used for three main functions: texting, taking photos and using the calendar function. Voice calling was predominately to contact parents and employers. It was also discussed that the newer models of smartphones were also high theft items, which could cause owners to be targeted for their device. The participants personally knew of incidents where someone's smartphone was stolen while at school.

Students' Experiences With Educators When Using Their Smartphones

When the focus group began to discuss the role of smartphones in the classroom and how educators perceived their role in education, the comments centered on the lack of consistency by educators and administrators. Classroom policies vary from educator to educator and between the two schools that participated. According to the participants, most educators view students' devices as distractions rather than as tools. Some educators do not trust that students are using their devices in a constructive manner and assume that they are being used for inappropriate purposes such as texting, gaming, updating social networking sites and cheating on tests. These educators' classroom policies include that smartphones are not allowed in the classroom and disciplinary actions are taken if seen. Some of these consequences include the device's

confiscation and or disciplinary action from administration. Students commented that even a single educator's policy could differ between classes. Depending on how the student utilized these devices, the educator may allow these devices to be used as long as the student is perceived as using them in a constructive manner for learning. Some of the examples given by the students including teachers announcing that student could use their smartphone to conduct research at a specific time or to record a group discussion. At one school, its policy is that these devices may only be used between periods and during lunch while the other school leaves it to the discretion of the classroom educator except in the main office where these devices are supposed to be turned off and put away.

The focus group participants reported that some educators have embraced technology to varying degrees. Educators who are in the early stages of embracing mobile technologies allow these devices to be used for limited purposes such as adding assignments to the device's calendar or using its calculator function. Other educators who have fully embraced these devices as learning/teaching tools encourage students to use its various functions as long as it is for educational purposes to aid students in their course related learning. Some of the students' educators have incorporated educational apps in the courses such as Edmodo and graph plotting. Without being prompted, the students' conversation began to center on how they appreciated the use of educational apps and wished that their other educators used these tools as well. Their educators initially introduced most of the students to the educational apps but once the students began to use them, they began to explore other ones as well. Interestingly, the students commented that a sharing of preferred apps began amongst the students as well as the educator. The students preferred educators who were open to exploring and using new apps and questioned why other educators found it difficult to embrace smartphones in the classroom especially

considering how important these devices are to the students personally and the role that they have in society.

Educators' Pre-activity Views

Ontario Communication Technology Curriculum Embraces Smartphones

Because both participating educators were Communication Technology educators, there was early implementation of the Ontario curriculum and exploration of the smartphone as a learning tool. Emailing and posting of notes on social media such as Facebook and Twitter and the administrative tasks of recording attendance and mark submissions were examples employed by both educators. The educators also encouraged students to use the mobile app for android and iPhones to access information and marks.

Educators' Responses For Smartphone Uses in and out of the Classroom

Both educators enjoyed the flexibility and mobility that smartphones added to their teaching practice. They especially liked the ability to respond to students' questions outside of the classroom as well post information and marks for assignments. Both educators commented that they were finding more ways to incorporate smartphones in a meaningful way into their courses and teaching practice. Their students have responded positively whether or not they personally own a smartphone. The educators explained further that the students who did not own their own device either borrowed or partnered with a student who did. Information or material created with a smartphone devices was shared either from device to device or was emailed or posted on the classroom's website for the other students. This also applied to students who were absent. The educators did recognize that there were challenges in allowing and encouraging

these devices in their classrooms and found that classroom management issues do arise. However, they saw these issues as an opportunity to educate students on socially appropriate use. At K.C.I., the educator had an educator candidate from the Queen's University, Faulty of Education. He participated all of the projects activities as part of his placement. The educators and student educator discussed various educational apps and how they could be utilized both in and out of the classroom as a course enhancement tool as well as a way of expanding learning outside of the classroom. The student educator used some educational apps while in his undergraduate program in mathematics and used some graphing apps in his courses. He stated that, while in his Faculty of Education program, he had limited exposure to educational apps and how smartphones could be utilized in the classroom. Based on our discussions, he said that he could see that exploring the use of these devices in an appropriate manner could enhance a student's learning experience.

Educators' View why Smartphones are not Being Utilized as Teaching Tools by all Educators

The conversation then shifted towards what was preventing other educators from adopting the use of smartphones. The educator from K.C.I. expressed frustration when valuable web based apps are blocked by school board firewalls (e.g., box.net), as well as the need for the infrastructure to be in place for there to be a high level of success in its adoption. At the time of this paper's study, Wi-Fi was not readily available throughout the schools, but only in a few designated areas as the cafeteria and main office. Along with the necessary infrastructure, it was recommended subject specific training to also be in place so that there could be a higher rate of adoption by reluctant educators. This could take place as a professional development activity

that could be implemented at the school board level. This point follows the Integrated Technology Adoption and Diffusion and the TAM2 model that outlines the need for administrative support and training as well as the relevancy of technology to the learning environment.

Although the adoption and use of smartphones was considered valuable, there was also concern about the affordability of technology and its apps. The web-based tool Edmodo is free for both educators and students, but more of these tools need to be developed and made available so as to increase access to these types of learning environments for socio-economically disadvantaged students. Having students who did not own or have access to a smartphone, work with a partner to participate in and complete the assignment solved this problem.

Some of the difficulties that the educators encountered preparing for the activity included having difficulty finding a website on which to host their video instructions so that they could be accessed on a mobile device with constricted bandwidth. There was also the challenge of website restrictions with some video hosting sites such as YouTube when students used the free Wi-Fi services while on school property. For the students who are not allowed to own a smartphone because of parental concerns about the benefit and validity of theses devices, this activity gave parents an opportunity to explore the benefits of these devices for this assignment with their child.

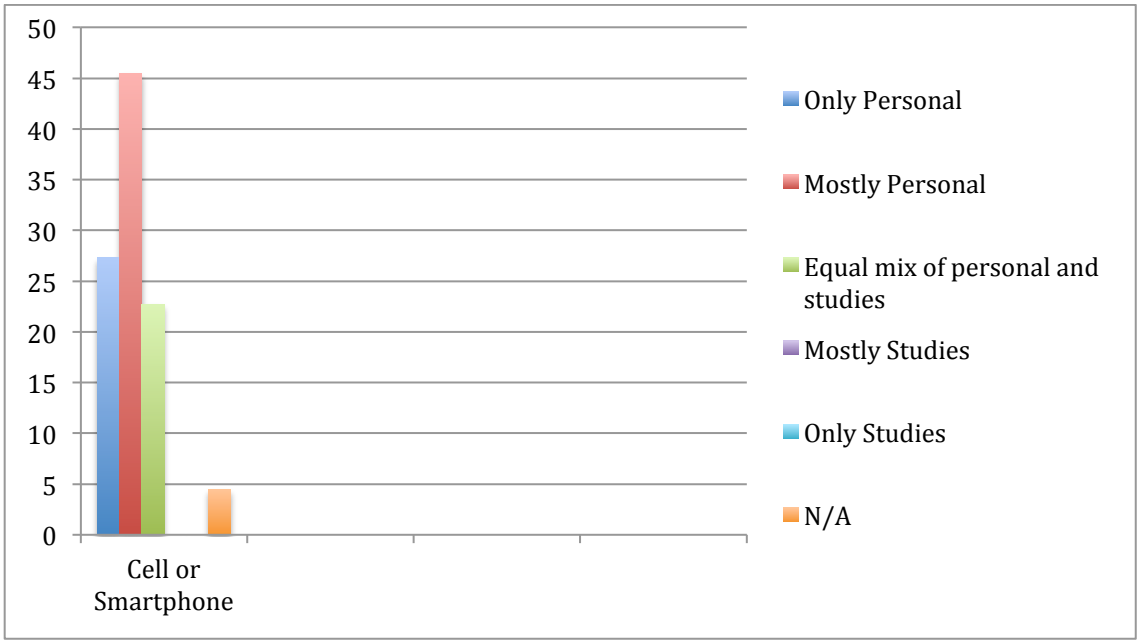
Pre-activity Qualitative Results

Students' Smartphone Uses

In the qualitative study, 36 students indicated that they use their device to text and 18 students use it for audio communication (Skype, MSN, phone) daily, but 24 students never use

their device for video communication. Some of the participants during the focus group commented that the only time that they use audio communication is with employers and parents, as they preferred texting with their peers. Regarding communication by email, the respondents were almost equally split with 11 students using their computer and 12 students using their smartphone daily. Twenty nine of the students access social networking daily, such as Facebook and Twitter. During the pre-activity focus group, these were listed as the two most preferred ways of communicating. Twenty two students use these sites for personal reasons only, 29 students use them for a mixture of personal communication and academic study, and one for only studies. Equal number of the respondents (29) indicated that they are very confident operating their cellular or smartphone and could teach others how to use it.

Figure 8: Cell or Smartphone Usage by Participating Students



The majority of the students, who own or have access to a smartphone, used it for personal reasons while only 4 students used it for studies. The secondary use, chosen by 22 of the respondents, is for gaming (see figure 4). During the group discussion students said that they

primarily use their smartphone to stay in contact with their friends through texting and social media websites such as Facebook and Twitter. They liked that the portability of their devices which allowed them to stay in contact with their friends from anywhere and at any time. When asked how they used their smartphones with their employers, they said that it was only to call to check their schedules and to enter their schedules into its calendar. Analysis of these responses indicates that the students view smartphones primarily as a personal tool that provides entertainment and allow the students to remain in contact primarily with their peers and then family and employers. What was initially lacking was an initial recognition of these devices as a learning tool.

At first most students in the focus group did not feel that they frequently used their smartphones for studies other than to check facts through their Internet browser. After a short time the list of applications grew as students discussed how they used their smartphone: checked their spelling with dictionary websites, took notes especially when computers were not available and shared them with social media websites. They also employed their calendar and alarm clock functions. Some of the students' courses also had them using their devices to produce video blogs, take photos of notes and diagrams and use their device's web browser to conduct research. In the quantitative study findings, 11 students use their device's calendar functions: 17 students mostly do so for educational purposes. The qualitative research indicated that 13 students use their smartphone's calculator function daily for personal use while 14 students mostly use this function for both personal and educational purposes. However, 11 students do so for only educational purposes. Ten students used their device to create multimedia items (such as photographs, movies and slideshows) monthly with equal respondents using it weekly and this was only 2 students fewer than those who use a computer. Corresponding to the respondents'

use of their device as an educational tool in a limited manner, 20 respondents do not use their device to collaborate or share document. Seventeen of the respondents have never used their device to search for articles on the Internet. Of those who use their device's browser, 13 respondents searched for these articles for either personal or educational purposes. Other types of multimedia searches include 16 respondents stating that they search for short videos, such as on YouTube but 22 only do so for predominantly personal use.

The respondents' pre-activity opinions fall in line with the existing literature that describes students not naturally gravitating to used their smartphone for educational purpose as in iPod, uPod? An emerging mobile learning tool in nursing education (Maag, 2006). It was also noted that 31 of the respondents never downloaded books using their device, and of those who did only 7 did so for solely educational purposes.

These results also reflected the quantitative study results as less than half (20) of the respondents indicated that they used their cellular or smartphone to create electronic documents (word processing, presentations and spreadsheets). Interestingly, 24 of the respondents said that never used their smartphone for these activity types. Only 9 students used their devices daily for these activities and 6 of them use their device a few times a week and 6 others use it for a few times of a month.

Activity Observations

Students frequently had to be reminded to communicate solely with their educator through their mobile device. Some students questioned the purpose of having to use their device rather than the more traditional face-to-face approach--especially with the close proximity of the educator at that moment. The educators had to explain that valuable time is wasted seeking out

the educator rather than using the tools at their disposal. The example was given that a broadcasting journalist would not fly back to his/her station to discuss any challenges or questions with their producer but use telecommunication methods instead. These students became less resistant to using their device to communicate with their educator and continued working on their assignment.

Of the students who were able to independently work off campus, some the students neglected to contact their educator as they forgot that they had this option Other students chose to remain at the school even though they were given ample time to travel to other locations. For the students who did not exercise this option, it limited their interview opportunities and therefore the level of success with their assignment. The grade 10 students had a more restricted time period in which to complete their work and some of the students chose to remain on school property. These students had more difficulty finding students who saw the validity of their assignment and not all of the students interviewed conduct themselves in a serious manner. When later asked why they chose to stay on the school property, some of the students indicated that they worried that they may be late returning to the school while some of other students did not perceive any value in completing the assignment off site. The educators and student educator were surprised that some students did not want to take advantage of travelling away from the school campus to conduct their interviews while others quickly headed to more distant locations.

Post Activity Focus Group Results

Study Challenges for Students

Upon their return to the classroom, many of the students stated that they could not play the initial video instructions on their smartphone and had to resort to using a classroom desktop computer. After various hypotheses were discussed, it was believed that the school's Wi-Fi bandwidth restriction prevented the video uploading properly.

The students stated that it was difficult to get adults to participate and be interviewed with a smartphone. Some of the students stated that this was due to people not viewing their work as a valid assignment. Some of these adults wanting physical proof such as student school identification and even had the students point to their educator before being allowed to be interviewed. Other students indicated that it was because of the perceived negative view of teenagers. The general consensus was that female adults and older males were more willing to be interviewed. Some of the concerns that were voiced to the students included that the video would be posted on YouTube and the validity of the assignment. Many felt that a school assignment using a smartphone would not be assigned, as it was perceived as being "too easy."

Other challenges referred to the limitation of the smartphone and its apps that were used. Although free Wi-Fi was utilized at the off-campus locations, there were problems with signal inconsistency. Also discussed was the audio and video quality produced as well as the inability to perform video editing so as to eliminate unwanted video clips and to combine all of their interviews into one file. Students also commented that battery life could be problematic for a student finishing an assignment since using a smartphone's peripheral's devices quickly drains the smartphone's battery life.

Benefits For Students

Assignment Format

During the post activity focus group, students commented that the format of the assignment allowed for a quicker completion compared to the more traditional approach that would require students accessing computers and video cameras. The students especially liked the fact that they had all of the tools necessary in one device and that there was "nothing to carry" and that they had "everything in the palm of their hand." The students found that research for their news story was easier to conduct using the smartphone. Students utilized their browser to search Google for topic information and ideas as well as access maps for locations. Because some students found it difficult to video interview people, they chose to post questions on Facebook and Twitter. By using social network sites, they found that more people were willing to share their viewpoints than by face-to-face communication. This could be attributed to the anonymity belief of posting on a social networking Internet site. Some students also arrange to interview fellow students by texting and tweeting them to meet at an established location.

From this assignment the general consensus was that it showed the participants the importance of technology and learning how to use it.

Smartphones as a Learning Tool

The students value the option of being able to get in contact with their educators in order to answer their questions outside of the classroom. They did not believe that an educator should have to respond immediately, but they appreciated that an educator could help them move forward with an assignment should a question arise. This point should alleviate any educator's

concern of the erosion of his or her personal life. The students also saw that smartphones could help a student to remain in contact with their educator and classmates when absent and still allow a student to contribute to group work and submit other assignments. The mobility of smartphones allows students the opportunity to work anywhere at any time including whether due to illness or away because of personal reasons.

Students also liked how they could access their personal email on their devices in order to confirm signing up for web-based tools as personal email services are blocked on school board computers. In classrooms that do not have computers, smartphones allow student to research topics, watch instructional videos and create documents that can be shared and automatically synced with a personal computer. Students also saw the benefit of using alternative communication methods such as Skype and IMS to obtain and exchange information.
The built-in peripherals on smartphones allow students to capture and share information. The camera allowed students to take photographs of posted notes on classroom white boards and group notes. These notes can be shared later through text and email attachments. Audio recordings of educator's lessons as well as group brainstorming sessions could also be reviewed and shared. The use of personal smartphones was perceived as more personal and offering more security than using a school computer. Most notably was the viewpoint shared by the participants that a smartphone allowed learning opportunities since "you always have it."

Should educators use smartphones as a learning tool and how should they be used?

Students were unanimous in their belief that educators should use smartphones as learning tools since homework could be pushed to students either through email, texting or web based learning tools such as Edmodo. They commented further that they would like each course to have its own on-line site and use forums to post course information. They would also like that

notes to be blogged and bonus questions could be posted. Students could also continue the learning dialogue outside of the classroom by asking educator and their classmates any course related questions. An on-line course forum would also allow students to revisit course materials or on-line dialogues.

Will you use your smartphone in the future as a learning tool either in or outside of the classroom?

The students voiced the opinion that they would like to do more assignments with their smartphone and hoped that the opportunity arises. Most of the students also stated that they downloaded or explored new or existing app and smartphone features to use in the future both in and out of the classroom. Since most of the students used their smartphone as a learning tool at least once, they saw the benefit of incorporating it further in their learning. Some of the students said that they wanted to show other educators how they could use it in their course in hope that these devices would be welcomed and utilized in the future. When the issue was raised that some post-secondary programs have formally integrated smart devices into their programs, students saw the value of learning how to use these devices in their education immediately so that they will know how to better use them when a post-secondary course or job requires it. The students view smartphones as more convenient and ergonomic benefit as they eliminate the need to carry heavy school or laptops bags. Even the more powerful smartphones and their apps are generally much less expensive than buying hardware and software while providing the functionality required. One of the students commented how they were able to buy a $10 app to edit a photo while the same desktop software version was hundreds of dollars more. The software version may offer more options, but the app generally is sufficient to do the job. One student commented that she is able to do presentations on her smartphone that she projected with

a classroom projector thus eliminating the need for an external drive or access to a computer. Even without a projector, the student could show her presentation to an educator.

It was also suggested that students should be able to download their textbooks to their devices preventing them from being forgotten and eliminating the need for school bags. Most of the students commented that they wished that schools were paperless with all of their assignments being submitted electronically so as to eliminate the need to print assignments and to prevent them from being forgotten. Because students always have their smartphone with them, they view this option as making school more convenient and ecologically responsible.

Discussion

Smartphones' expanding features and apps have led to these devices ubiquitous presence in society and have elevated them as an essential tool. This has raised the skill of utilizing smartphones' features as an essential 21st century skill that needs to be incorporated at the secondary level. Whereas professionals view smartphones as a tool, teenagers' demand and use of smartphones has been more socially focused. Teenagers have elevated these devices from being not only desirable but as an extension of themselves. This is one of the reasons why smartphones have had limited success as a learning tool at the secondary level. These devices' features and apps offer a variety of ways to enhance the learning environment and students and educators need to be able to distinguish between these devices merits and challenges, as described by Papert (1998), so as to harness their true potential as a teaching and learning tool. This is part of the early stage of the M-LAAT model that requires educators and students to examine their perceived values and experiences with smartphones in order to develop students' learning skills with smartphones.

In order to increase the successful adoption of these devices as both learning and teaching tools, at the secondary level, an action plan must be developed that addresses all technical, policy and curriculum issues. Meaningful and subject specific curriculum needs to be developed that encourages learning opportunities both in and outside of the classroom, but before the implementation of any curriculum, training must be put into place for educators, administrators, support staff and students.

It is important to recognize that although students may use these devices daily, they may not know how to use them as a learning tool or that they can be essential to the learning process. Traditionally learning has been embraced as an activity that takes place in a student's school, we need student to recognize and want to expand learning to occur wherever students are. Although the educators who participated in the study have embraced various mobile technologies, it cannot be assumed that all educators have learned and are utilizing these devices. Because we cannot assume that the classroom educator is using a smartphone in his or her personal life, it is important that mobile technology professional development workshops are offered to educators that address smartphone basic operation skills as well as how they can used as a teaching/learning tool. This also applies to administrators. If an educator or administrator doesn't know how to operate these devices various features and apps, how can they welcome them to the learning environment?

Utilizing the experiences of educators who have successfully incorporated smartphones in their learning program, other educators will see the advantage that these devices offer. To further ensure the successful adoption of smartphones as a learning/teaching tool, educator-training programs also need to incorporate a mobile technology component along with the other technology that they teach to educator candidates.

Due to the relatively newness of these devices and their acceptable use, educators have the opportunity to teach and model to students how and when to use smartphones so that they are a tool and not hindrance to the learning or work environment. As these devices provide the opportunity to expand the learning environment, all parties in education need to embrace and learn how they can be used. Policies need to be amended to encourage the use of smartphones. As both learners and educators have varying skills levels with these devices, the teaching of how and when to use the features of these devices must be added to today's curriculum. In order to increase today's youth chance of being successful in society, we need to change how and where we teach and learn by utilizing mobile technology skills. By doing so it will expand the learning environment, as described by Sharples (2005), to take place anywhere with these new digital skills and in doing so enhance and expand the learning environment both in and out of the classroom.

This action plan must include administration and the school's technical support network so as to create an environment that will increase the successful use of these devices. It is critical that any technical issues such as the availability of smart devices for the classroom or Wi-Fi bandwidth issues are addressed.

Throughout this study I continued to explore both students and educators views of smartphones as a learning and teaching tool. In a later follow up discussion with the educator from K.C.I, he described that he was finding more ways to incorporate mobile technology in his program that was being explored by his students. He was amazed by the possibilities that smartphones offer to the learning and teaching environment. He commented that smartphones not only have the ability to bridge technology accessibility in the classroom due to budgetary issues but that more economically challenged students had access to this technology and its apps

as it had the potential of being more economical. Long term contracts for Internet accessibility can be avoided with pay-as-you-go plans. These devices Wi-Fi function can allow students to use free Wi-Fi hotspots so as to conduct any work using their smartphone's browser. He further commented that the student who participated in the study had increased using their mobile devices as learning tools. He also recognized that these devices could do anything that a computer can do and encourage action due to their accessibility and availability. He was seeing an increase in students pushing away classroom computer keyboards in favour of their smartphone. Finally, he shared a story that one of the educators in his school created and used a QR code for a competition vote; the educator credited a 30% increase in votes by using this mobile tool.

My own students who participated in the study have not only increased how they use their smartphone in learning, but have also tried to encourage their other educators to adopt this methodology by trying to show how they are using their smartphone and ways that they can be utilized in various subjects. Examples of new ways that the students who participated in this study are using their smartphones include tweeting notes to group members, creating course discussions on various social networking sites, sharing notes and developing vocabulary lists.

When another educator asked me how has my view of the role of smartphones in the classroom has evolved, I explained that the more that I allowed and encouraged these devices to be explored as a learning tool the less they became a classroom management issue. Students need to learn more than the standard curriculum; they need to learn not only "how" but "why" to learn. In doing so, students can discover that learning can be fun and can take place anywhere. After a presentation and discussion that I led at the EdCamp Waterloo (Flood, Smartphones As a Learning/Teaching Tool, 2012), one of the attendees tweeted: "Put devices in students hands,

leave them alone & they will come back & teach you something - wise words at #edcampwr from@kimberleyflood" (Hanson, 2012). The possibilities of utilizing smartphones in education needs to be explored so as to aid today's secondary student to further succeed with the demand of the new 21st century skills.

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Appendices

Link to Qualitative Survey

http://www.surveymonkey.com/s/UseofTechnology_student

Sample of how Students Were Given Instructions to Participate in the Project.

Using your smartphone's QR Reader app, scan the following QR Code below to gain access to your assignment's video instructions.

Sample Page of the Broadcasting Assignment Rubric

Grand River C.I.

175 Indian Road
Kitchener, ON
N2G 4M1

Name: _____
Date: Tuesday, May 17, 2011
Teacher: Ms. Flood
Course: Communications Technology, Grade 11, University/College

TV Broadcasting Assignment Using Smartphones

Like in industry, you are required to go find a story that will engage the viewer for today's newscast. The station's producer needs you to produce a 2-3 minute news segment after viewing your "assignment" requirements. View your web assignment notes and get your assignment in within 3 hours starting.

Overall Expectations

11B1	apply project management techniques to develop communications technology products effectively in a team environment
11A3	demonstrate an understanding of technical terminology, scientific concepts, and mathematical concepts used in communications technology and apply them to the creation of media products
11B2	apply a design process or other problem-solving processes or strategies to meet a range of challenges in communications technology
11B3	create productions that demonstrate competence in the application of creative and technical skills and incorporate current standards, processes, formats, and technologies
11C1	describe the impact of current communications media technologies and activities on the environment and identify ways of reducing harmful effects
11D1	demonstrate an understanding of and apply safe work practices when performing communications technology tasks
11D2	demonstrate an understanding of and adhere to legal requirements and ethical standards relating to the communications technology industry

Specific Expectations

11A1.2	demonstrate an understanding of the concepts (e.g., video and photography composition, appropriate audio levels, audio and video continuity, animation fluidity, balanced layout, basic lighting) and creative techniques (e.g., lighting, image manipulation and editing, composition and framing) required to produce effective media products or services
11A3.1	demonstrate an understanding of communications technology terms, and use them correctly in oral and written communication (e.g., kerning, framing, key frame, jump cut, peaking, video switching, audio levels, dissolve, resolution, masking, file management, storyboard)
11A3.2	demonstrate a basic understanding of scientific concepts that relate to processes and technologies used in communications technology (e.g., light and colour theory, acoustic theory, persistence of vision, sensor operation)
11A3.3	use appropriate formulas and calculations to solve problems in pre-production, production, and post-production work (e.g., calculating frame rates, timelines, resolutions, file compression ratios, scaling)
11A4.2	describe and apply concepts and techniques that facilitate effective collaboration in a team environment (e.g., cooperative discussion, conflict resolution techniques, providing opportunities for all to participate, listening, respecting the ideas of others, constructive criticism)
11B1.2	use a variety of planning techniques and tools (e.g., research, design briefs, task lists, scripts, mock-ups, storyboards, site maps, project-planning software) when creating plans for communications projects
11B2.3	use a variety of information sources and research techniques to help identify possible solutions (e.g., Internet and library searches, checking manuals and other printed materials, consulting experts)
11B2.6	evaluate possible solutions to identify those that most effectively meet the objectives and criteria within the existing constraints
11B3.1	use appropriate procedures to set up and operate media production equipment (e.g., audio, video, or graphic systems; studio lighting systems; electronic pre-press equipment; printing systems)